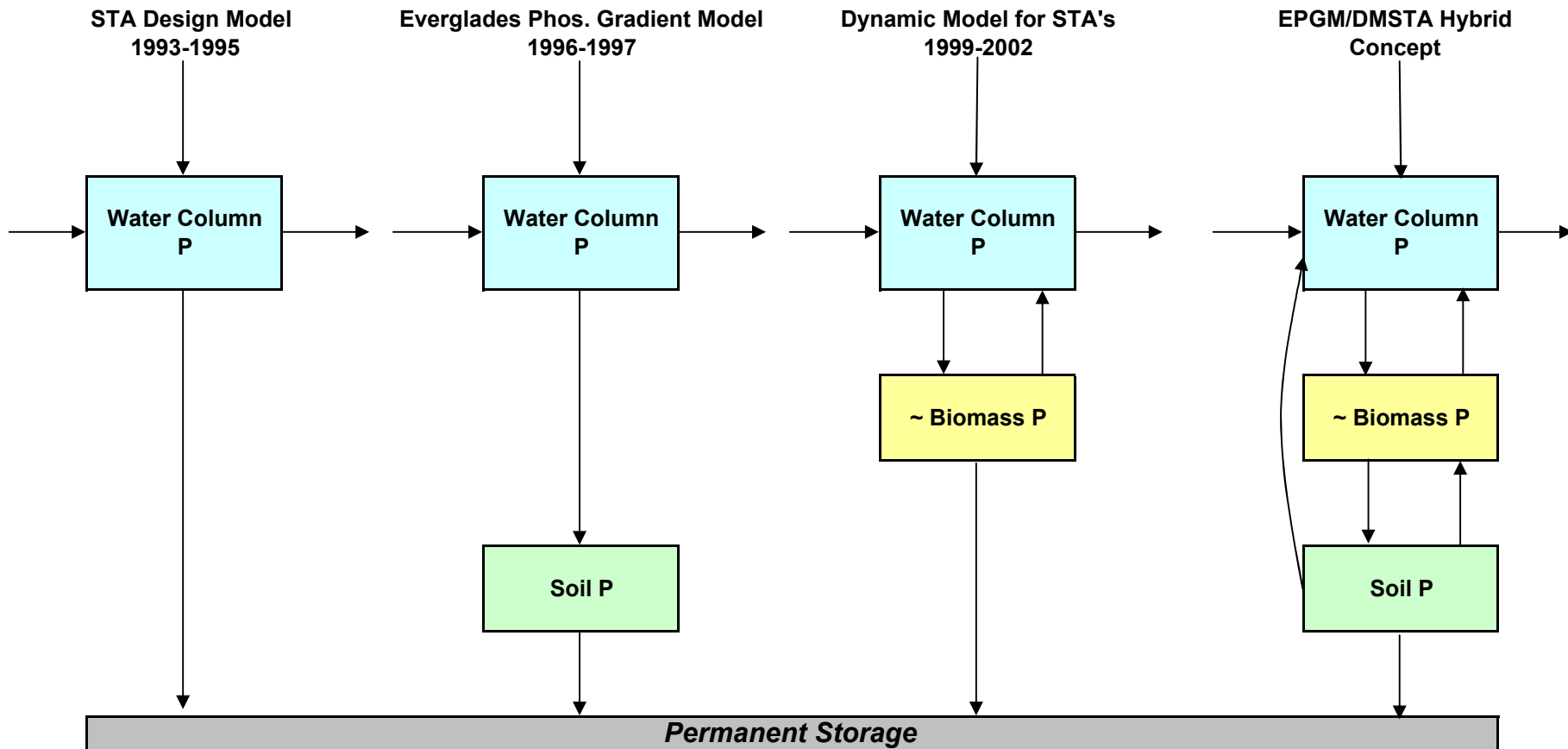


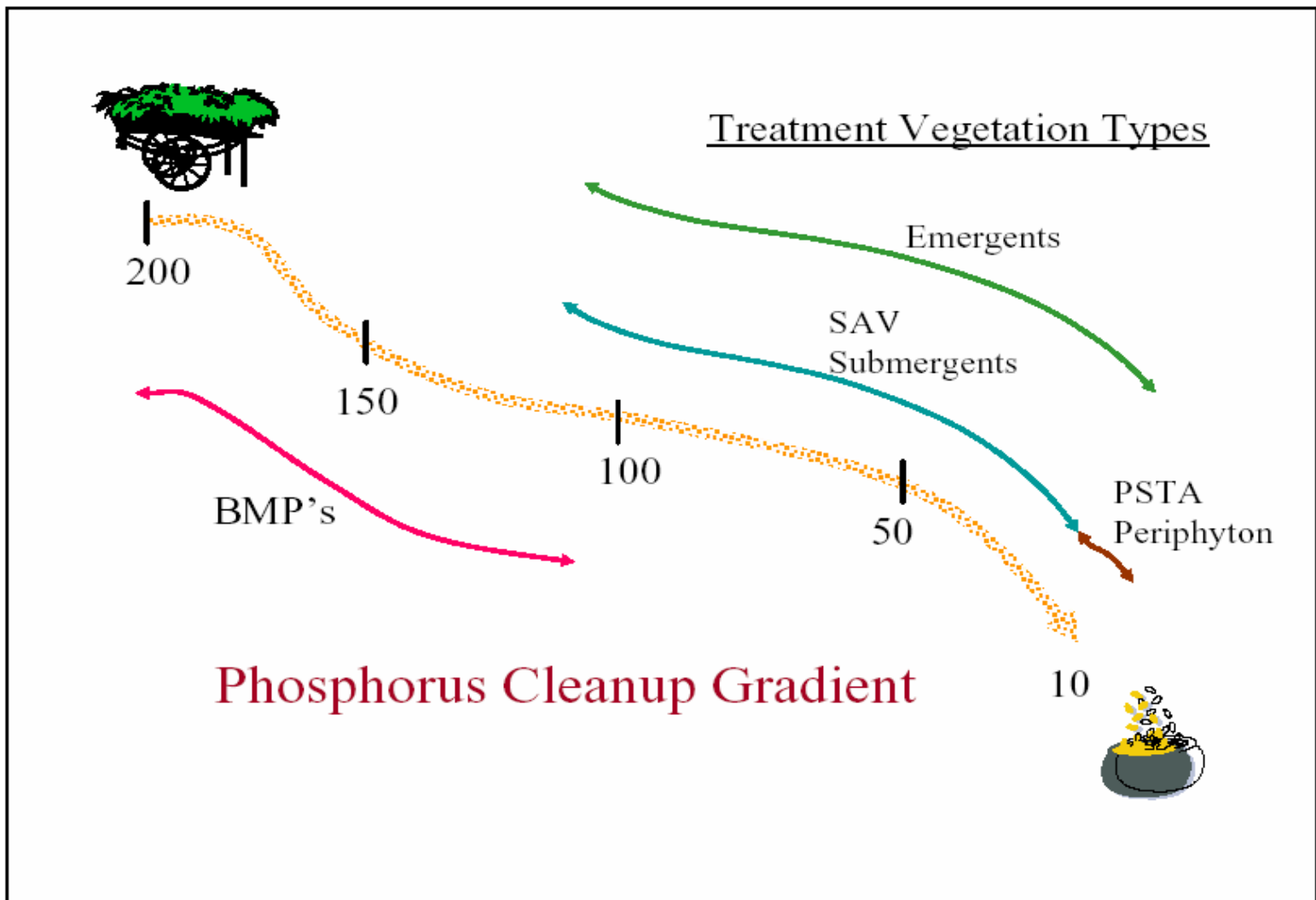
# Phosphorus Balance Models for Everglades Applications



## Phosphorus Mass Balance Models Developed for Everglades Applications

W. W. Walker & R.H. Kadlec for U.S. Department of the Interior

Model	STADM	EPGM	DMSTA	HYBRID
Description	STA Design Model	Everglades Phos. Gradient Model	Dynamic Model for STA's	EPGM/DMSTA Hybrid
Development Dates	1993-1995	1996-1997	1999-2002	Concept
Primary Purposes	Design of Phase I Stormwater Treatment Areas	Impacts of STA Discharges on WCA's	Design of Enhanced Stormwater Treatment Areas - All EPA Basins	Same as EPGM/DMSTA + WCA Recovery + CERP Applications
Applic. to Natural Wetlands	WCA-2A	WCA's	WCA-2A; C111	Everglades
Dynamic Time Scale	Steady State	Years	Days --> Years	Days--> Years
Computational Platform	Any Spreadsheet	Lotus or Excel	Excel / Visual Basic	Excel / Visual Basic
Wetland Trajectory	Steady State	Enrichment	Enrichment	Enrichment or Recovery
Spatial Configuration	Gradient ( Plug Flow)	Gradient (Plug Flow)	1-Dim. Branched (Cells in Series, Parallel)	General 1-D Branched or Linked to Existing Hydro Models (NSM Output)
Model Coefficients	1	3	3	7
Calibration Basis	WCA-2A, Treatment Wetlands	WCA-2A	~70 Platforms: Tmt Wetlands, Test Cells, Mesocosms	EPGM/DMSTA; Updated to Include Threshold Research, EPA REMAP; ENP & USGS Research
Soil Types	Peat	Peat	Peat or Marl	Peat or Marl
Vegetation Types	Emergent --> Slough	Emergent ---> Slough	Emergent, Submergent, Periphyton	Emergent, Submergent, Periphyton
State Variables	Flow Water Col P	Flow Water Col P Soil Accretion  Soil P Cattail Density	Flow Water Col P Biomass P Any WQ Comp. with Simple Kinetic Rules	Flow Water Col P Biomass P  Soil Accretion  Soil P Cattail Density Any WQ Comp. with Simple Kinetic Rules
Potential CERP Applications	Design of External P Load Controls	--->  Simulating P Impacts Downstream of Inflows	--->  Simulating P Impacts Downstream of Inflows Optimization of CERP Reservoirs for WQ Benefits	--->  --->  --->  Simulating Recovery of WCA/ENP Marshes
Relevant CERP Performance Measures		Vegetation, Periphyton, Soil Accretion	Vegetation, Periphyton	Vegetation, Periphyton, Soil Accretion
Reference: www.walker.net	/stadesign.pdf	/epgm	/dmsta	



# 27 Management Models to Evaluate Phosphorus Impacts on Wetlands

Robert H. Kadlec and W.W. Walker

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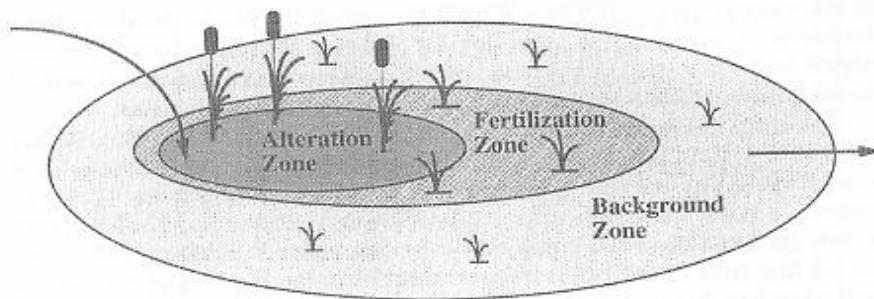


FIGURE 27.1 New phosphorus inputs tend to create zonation in the vicinity of the addition.

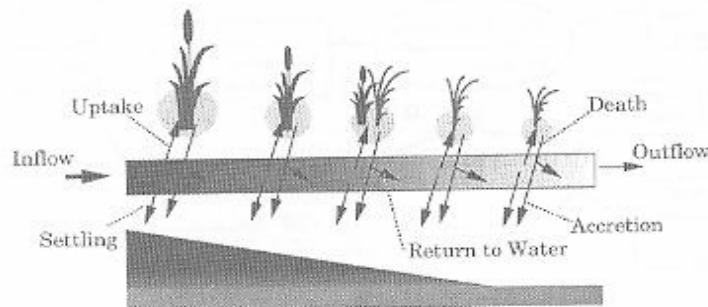
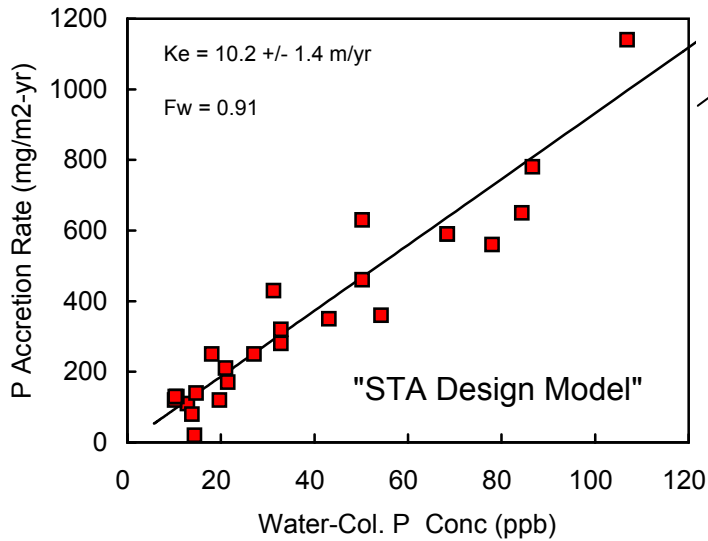
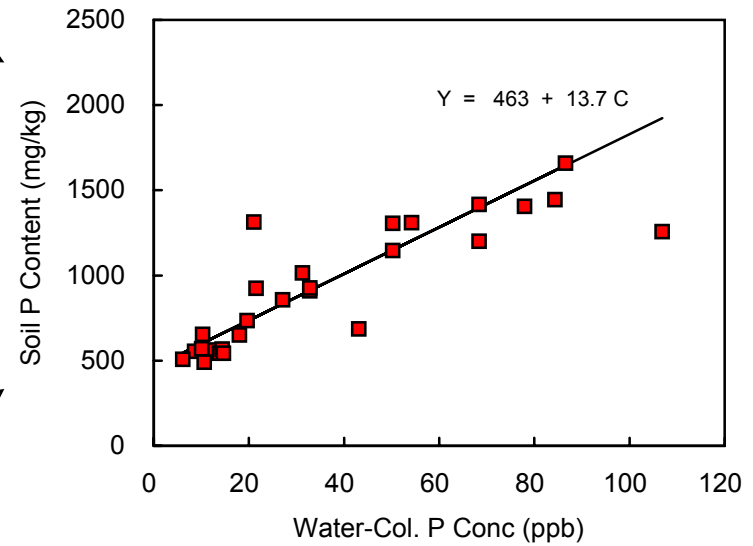
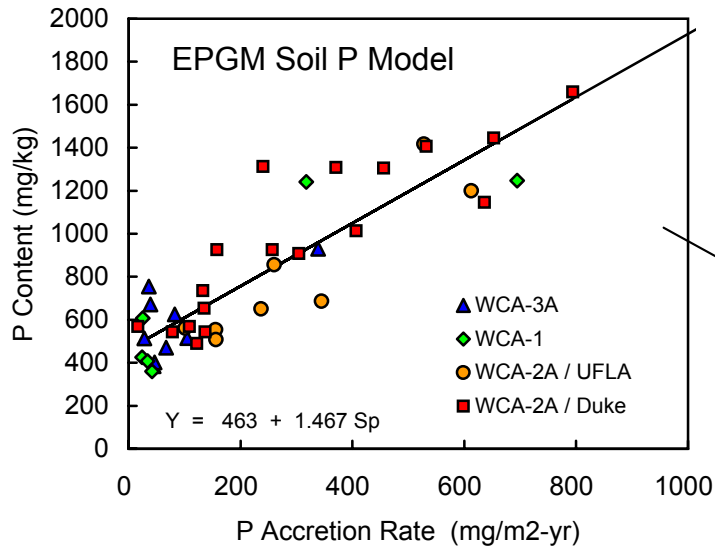


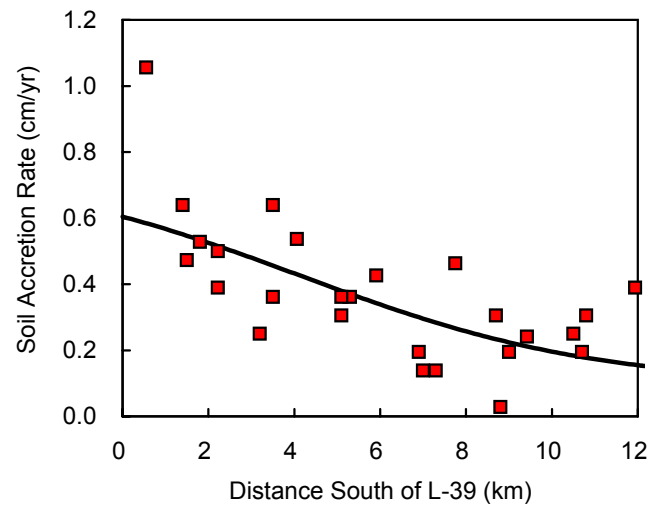
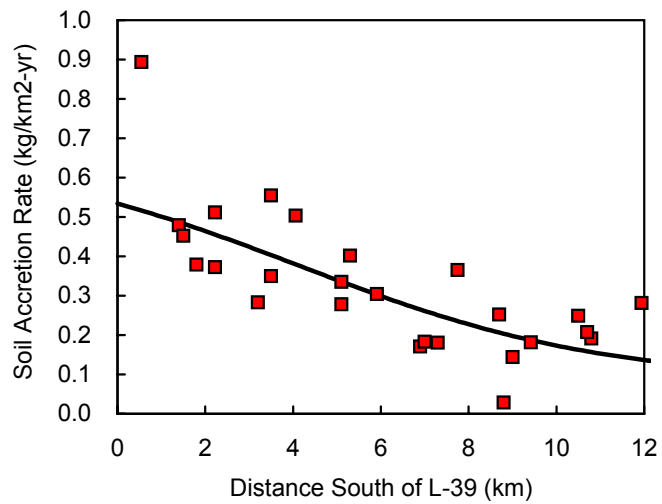
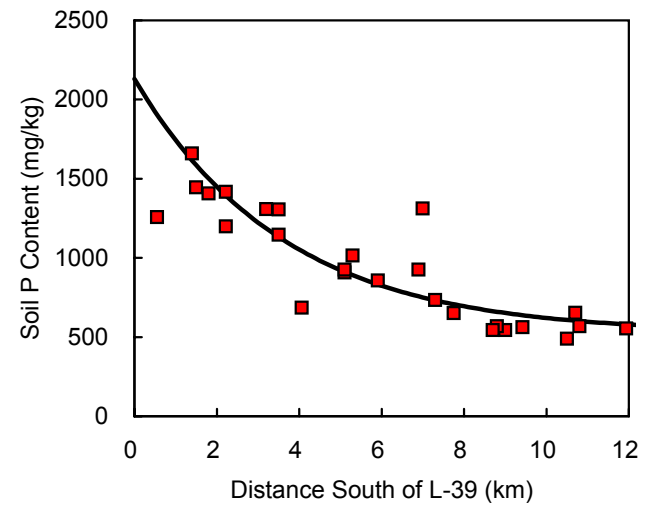
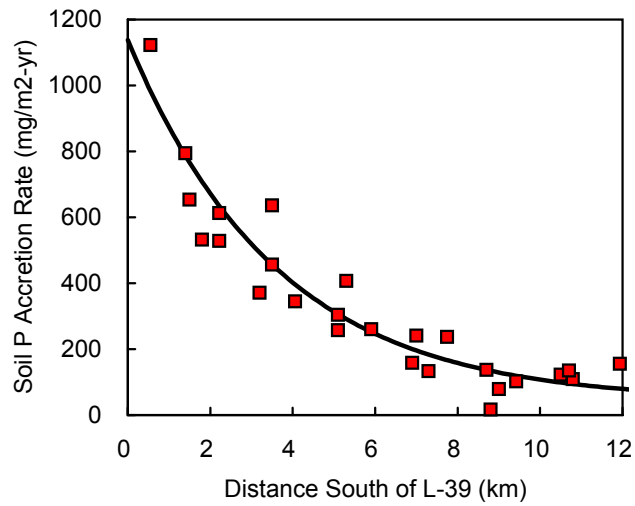
FIGURE 27.2 Gradients in surface water P lead to enhanced biomass, a larger biogeochemical cycle, and larger accretion rates for recalcitrant residuals. Arrows indicate the movement of phosphorus.

# EPGM Calibration - Soil P / Water P Linkages Derived from WCA-2A Data



Accretion Rates & P Contents in Soils above the Cs-127 Peak Corresponding to the 1963-1991 time period

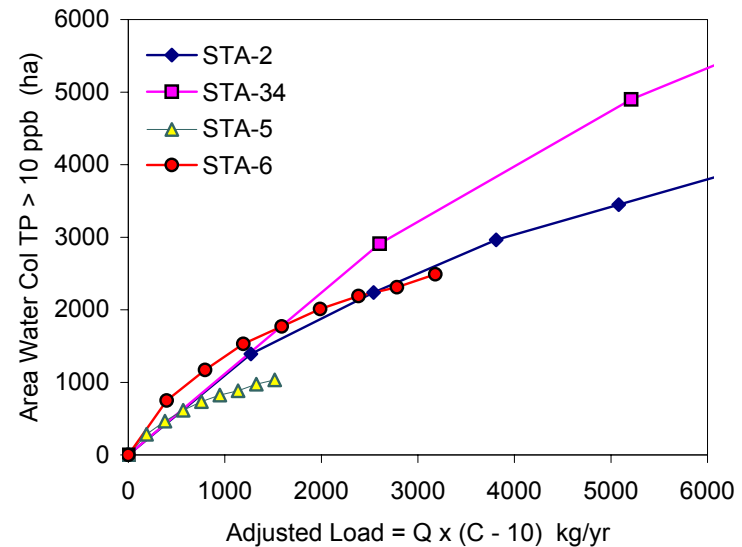
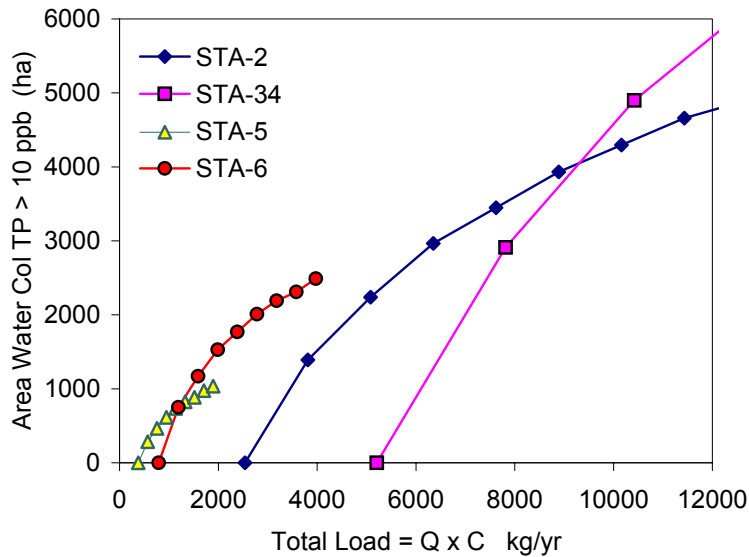
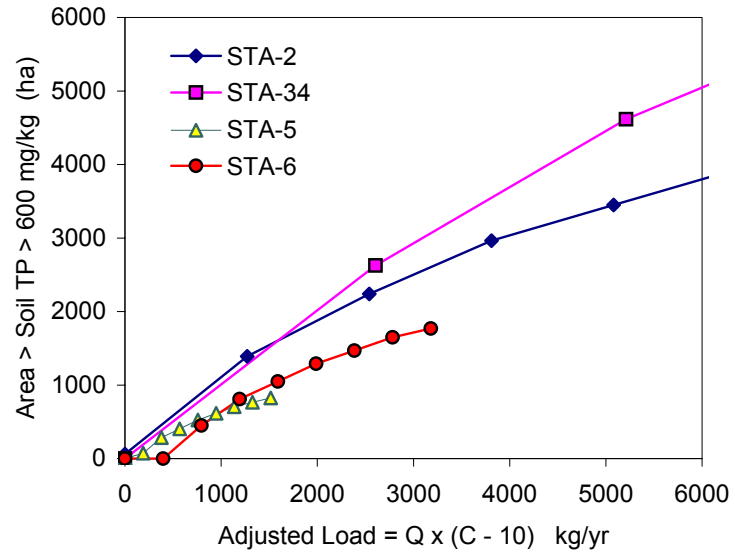
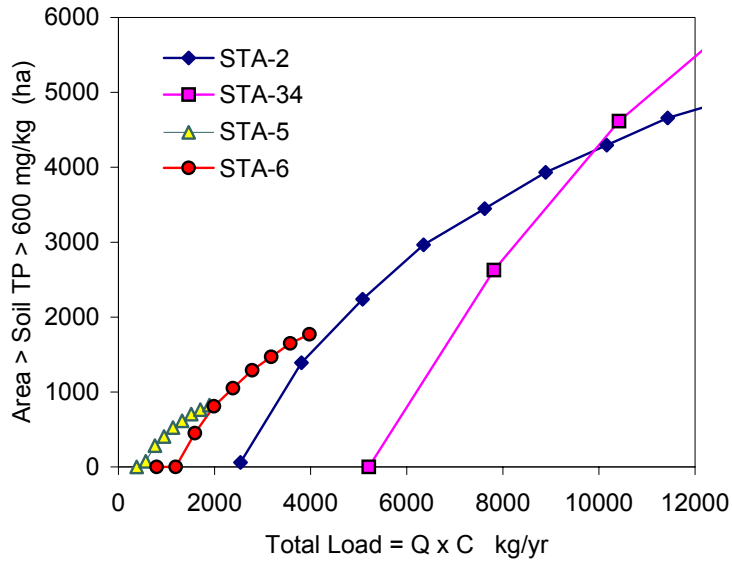
## WCA-2A Soil Properties Predicted from External P Load



# EPGM Simulation of STA Discharges through Hydropattern Restoration Facilities

Marsh Impact Areas vs. Total P Load =  $Q \times C$

Marsh Impact Areas vs. Adjusted P Load =  $Q \times (C - 10)$



Conclusion ?

Adjusted Load is a better surrogate for marsh impact areas, as compared with Total Load

## Alternative Predictors of P Enrichment Impacts Downstream EPA Inflow Points

For Discharges Directly to Marsh (vs. Canal)

Using Water-Column & Soil P Criteria

### Predictors Ranked in Order of Increasing Complexity

- 1 Total P Load =  $Q C$  existing CERP performance measure
- 2 Adjusted P Load =  $Q \times (C - 10)$  modified PM, more directly related to impact at steady-state
- 3 EPGM Steady State " " + accounts for hydroperiod, distribution width, geometry
- 4 EPGM Dynamic (Soil P vs. Year) " " + accounts for regional variations in existing soil properties
- 5 DMSTA Dynamic (Daily) " " + accounts for vegetation types & short-term load pulses
- 6 DMSTA/EPGM Hybrid (does not exist) " " + accounts for soil p reflux from previously impacted areas, etc.

etc...